The Short Period Variable W Ursæ Majoris.

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(*Communicated by Sir David Gill, K.C.B., F.R.S.*)

Observations of W Ursæ Majoris (B.D. + 56°, 1400, $\alpha = 9^h\ 36^m\ 44^s$, $\delta = 56°\ 24'{\cdot}6$, 1900), with the photometer D attached to the Steinheil refractor of the Potsdam Astrophysical Observatory, have been made by me during the last year as often as opportunity offered. This interesting variable, with a period of only four hours, was discovered by Müller and Kempf at Potsdam, and these observers have already published a light curve and ephemeris,* but it seemed desirable to have additional data for the light curve, and also of interest to observe some additional minima. In all, 263 observations were made, in each case the comparison star used being B.D. + 54°, 1329 ($\alpha = 9^h\ 41^m\ 44^s$, $\delta = 54°\ 43'{\cdot}7$, 1900), the magnitude of which from the Potsdam *Durchmusterung* observations is 7·73. As usual, each observation consisted of four settings for the variable star and four for the comparison star in alternate observations, the variable being observed before and after the comparison star.

In Table I. the complete observations are given, the columns containing successively the date and Potsdam sidereal time of observation, Greenwich mean time (with reduction to Sun applied), and the observed magnitude (corrected for atmospheric absorption). The remaining columns contain elements computed as explained later.

TABLE I.

Date. 1907.	Sid. Time. h m	G.M.T. h m	Mag.	C.	O—C.	Prec. Min. h m	Epoch.
May 29	13 54	8 33	8·08	8·16	− ·08	7 53	9568
	14 11	50	7·86	8·05	− ·19		
	18	57	7·95	8·03	− ·08		
	33	9 12	8·09	7·99	+ ·10		
	15 10	49	8·02	7·91	+ ·11		
	22	10 1	7·85	7·90	− ·05		
	27	6	7·86	7·90	− ·04		
	43	22	7·81	7·91	− ·10		
	53	32	7·77	7·93	− ·16		
June 5	14 22	8 33	8·51	8·27	+ ·24	8 2	9610
	37	48	7·92	8·11	− ·19		
	47	58	7·97	8·05	− ·08		
	15 7	9 18	8·11	8·00	+ ·11		
	16	27	7·98	7·98	·00		
	30	41	7·88	7·95	− ·07		

* *Ap. J.*, vol. 17, No. 201 (1903); *A.N.* 4005, 167, 347 (1905), and *A.N.* 4128, 172, 387 (1906).

TABLE I.—*continued.*

Date. 1907.	Sid. Time. h m	G.M.T. h m	Mag.	C.	O—C.	Prec. Min. h m	Epoch.
June 8	14 40	8 39	8·19	8·24	−·05	8 6	9628
	52	51	8·21	8·11	+·10		
	15 4	9 3	8·05	8·05	·00		
	17	16	7·87	8·01	−·14		
June 9	14 15	8 10	8·57	8·49	+·08	8 8	9634
	27	22	8·40	8·43	−·03		
	38	33	8·25	8·32	−·07		
	53	48	8·32	8·16	+·16		
	15 2	57	8·22	8·08	+·14		
	34	9 29	8·01	7·99	+·02		
June 19	14 54	8 9	8·59	8·41	+·18	4 21	9693
	15 13	28	8·57	8·47	+·10	8 21	9694
	19	34	8·55	8·44	+·11		
	31	46	8·41	8·32	+·09		
	38	53	8·20	8·25	−·05		
	51	9 6	7·96	8·11	−·15		
	57	12	7·96	8·07	−·11		
	16 23	38	8·03	7·99	+·04		
July 18	16 51	8 10	8·26	8·06	+·20	4 59	9867
	17 4	23	8·07	8·16	−·09		
	12	31	8·18	8·23	−·05		
	22	41	8·32	8·34	−·02		
	27	46	8·42	8·40	+·02		
	37	56	8·66	8·48	+·18		
	41	9 0	8·51	8·49	+·02	8 59	9868
	53	12	8·59	8·44	+·15		
	18 0	19	8·45	8·38	+·07		
	17	36	8·10	8·20	−·10		
July 22	17 20	8 24	8·23	8·12	+·11	5 4	9891
	30	34	8·18	8·20	−·02		
	33	37	8·17	8·23	−·06		
	44	48	8·38	8·35	+·03		
	48	52	8·47	8·40	+·07		
	18 4	9 7	8·51	8·49	+·02	9 5	9892
	11	14	8·27	8·46	−·19		
	21	24	8·29	8·38	−·09		
	26	29	8·24	8·32	−·08		
	35	38	8·22	8·23	−·01		
	44	47	8·06	8·13	−·07		
	56	59	8·07	8·06	+·01		

TABLE I.—*continued.*

Date. 1907.	Sid. Time. h m	G.M.T. h m	Mag.	C.	O—C.	Prec. Min. h m	Epoch.
July 25	17 9	8 1	7·97	7·97	·00	5 8	9909
	19	11	8·22	8·01	+·21		
	23	15	8·04	8·03	+·01		
	32	24	8·23	8·09	+·14		
	39	31	8·04	8·14	−·10		
	50	42	8·35	8·23	+·12		
	57	49	8·37	8·31	+·06		
	18 8	9 0	8·34	8·44	−·10		
	12	4	8·24	8·47	−·23		
Aug. 6	18 40	8 44	8·18	8·12	+·06	5 24	9981
	48	52	8·03	8·19	−·16		
	51	55	8·28	8·22	+·06		
	19 0	9 4	8·22	8·31	−·09		
	6	10	8·42	8·39	−·03		
	15	19	8·45	8·47	−·02		
	22	26	8·24	8·49	−·25	9 25	9982
	31	35	8·32	8·45	−·13		
	34	38	8·25	8·43	−·18		
	46	50	8·08	8·31	−·23		
	53	57	7·98	8·24	−·26		
	20 5	10 9	8·08	8·11	−·03		
Aug. 11	17 44	7 29	7·85	7·91	−·06	5 31	10011
	53	38	7·88	7·90	−·02		
	59	44	7·84	7·90	−·06		
	18 10	55	7·88	7·90	−·02		
	17	8 2	7·85	7·91	−·06		
	26	11	7·99	7·93	+·06		
	19 1	46	7·92	8·08	−·16		
	11	56	8·08	8·16	−·08		
Aug. 28	19 2	7 41	7·91	7·93	−·02	5 54	10113
	8	47	8·02	7·92	+·10		
	22	8 1	7·86	7·90	−·04		
Oct. 8	1 3	11 3	8·41	8·43	−·02	10 48	10360
	13	13	8·49	8·32	+·17		
	17	17	8·43	8·28	+·15		
	29	29	8·26	8·15	+·11		

TABLE I.—*continued.*

Date. 1907.	Sid. Time. h m	G.M.T. h m	Mag.	C.	O—C.	Prec. Min. h m	Epoch.
Dec. 6	4 24	10 37	7·94	7·91	+·03	8 6	10713
	36	49	7·94	7·93	+·01		
	42	55	7·82	7·95	−·13		
	53	11 6	8·06	8·00	+·06		
1908.							
Jan. 1	4 55	9 28	8·21	8·09	+·12	8 41	10869
	5 9	42	8·10	8·03	+·07		
	18	51	8·03	8·01	+·02		
	39	10 12	8·08	7·97	+·11		
Jan. 2	4 38	9 7	8·42	8·32	+·10	8 42	10875
	51	20	8·26	8·18	+·08		
	58	27	8·15	8·11	+·04		
	5 11	40	8·03	8·04	−·01		
	18	47	8·11	8·02	+·09		
	33	10 2	7·99	7·99	·00		
	44	13	8·04	7·97	+·07		
Jan. 14	3 41	7 23	7·88	7·91	−·03	4 58	10946
	52	34	7·98	7·92	+·06		
	55	37	7·96	7·93	+·03		
	4 8	50	7·89	7·97	−·08		
	14	56	7·99	7·99	·00		
	25	8 7	7·94	8·05	−·11		
	32	14	8·14	8·10	+·04		
	43	25	8·22	8·19	+·03		
	52	34	8·27	8·27	·00		
	5 6	48	8·60	8·43	+·17		
	11	53	8·33	8·47	−·14		
	27	9 9	(8·73)	8·45	(+·28)	8 58	10947
	36	18	(8·62)	8·37	(+·25)		
Jan. 25	3 46	6 45	8·03	7·96	+·07	5 12	11012
	51	50	7·85	7·95	−·10		
	4 1	7 0	7·91	7·93	−·02		

TABLE I.—*continued.*

Date. 1908.	Sid. Time. h m	G.M.T. h m	Mag.	C.	O−C.	Prec. Min. h m	Epoch.
Mar. 22	12 15	11 26	8·14	8·05	+·09	10 28	11355
	26	37	8·11	8·01	+·10		
	31	42	7·92	8·00	−·08		
	42	53	7·95	7·98	−·03		
	48	59	7·93	7·97	−·04		
	58	12 9	7·89	7·94	−·05		
	13 4	15	7·88	7·93	−·05		
	16	27	7·91	7·91	·00		
Mar. 24	12 9	11 12	8·13	8·15	−·02	10 31	11367
	21	24	8·10	8·06	+·04		
	26	29	8·10	8·04	+·06		
	41	44	7·82	8·00	−·18		
	49	52	7·95	7·99	−·04		
	13 4	12 7	7·91	7·95	−·04		
	10	13	7·86	7·94	−·08		
	25	28	7·93	7·91	+·02		
Mar. 25	12 6	11 5	8·27	8·24	+·03	10 32	11373
	18	17	8·07	8·11	−·04		
	25	24	8·00	8·07	−·07		
	36	35	7·86	8·03	−·17		
	41	40	7·97	8·02	−·05		
	58	57	7·98	7·98	·00		
Apr. 15	12 46	10 20	8·36	8·13	+·23	7 0	11498
	54	28	8·19	8·19	·00		
	59	33	8·48	8·24	+·24		
	13 8	42	8·46	8·35	+·11		
	18	52	8·55	8·45	+·10		
	29	11 3	8·55	8·49	+·06	11 0	11499
	34	8	8·57	8 47	+·10		
	44	18	8·62	8·39	+·23		
	50	24	8·29	8·33	−·04		
	59	33	8·25	8·23	+·02		
	14 3	37	8·31	8·19	+·12		
	13	47	8·09	8·09	·00		
	21	55	8·04	8·05	−·01		
	30	12 4	8·01	8·03	−·02		

TABLE I.—*continued.*

Date. 1908.	Sid. Time. h m	G.M.T. h m	Mag.	C.	O—C.	Prec. Min. h m	Epoch.
Apr. 26	13 23	10 13	7·83	7·99	− ·16	7 14	11564
	31	21	7·96	8·03	− ·07		
	37	27	7·98	8·07	− ·09		
	46	36	8·00	8·13	·13		
	51	41	8·13	8·17	− ·04		
	14 1	50	8·13	8·26	− ·13		
	6	55	8·32	8·32	·00		
	15	11 4	8·31	8·43	− ·12		
	21	10	8·42	8·47	− ·05		
	30	19	8·44	8·48	− ·04	11 15	11565
	35	24	8·43	8·46	− ·03		
	45	34	8·29	8·38	− ·09		
	57	46	8·24	8·25	− ·01		
	15 6	55	8·06	8·15	− ·09		
	12	12 1	8·15	8·10	+ ·05		
	21	10	8·07	8·05	+ ·02		
	30	19	8·06	8·03	+ ·03		
	40	29	7·98	8·00	− ·02		
May 3	14 8	10 29	8·15	8·03	+ ·12	7 24	11606
	17	38	7·95	8·08	− ·13		
	22	43	8·06	8·12	− ·06		
	31	52	8·15	8·19	− ·04		
	38	59	8·12	8·26	− ·14		
	47	11 8	8·35	8·37	− ·02		
	54	15	8·45	8·44	+ ·01		
	15 3	24	8·34	8·49	− ·15	11 24	11607
	11	32	8·53	8·47	+ ·06		
	20	41	8·37	8·40	− ·03		
	28	49	8·29	8·32	− ·03		
	38	59	8·26	8·21	+ ·05		
	48	12 9	7·95	8·11	− ·16		
	58	19	8·07	8·05	+ ·02		

TABLE I.—*continued.*

Date. 1908.	Sid. Time. h m	G.M.T. h m	Mag.	C.	O—C.	Prec. Min. h m	Epoch.
May 14	14 48	10 24	7·99	7·94	+·05	7 38	11672
	57	33	8·01	7·97	+·04		
	15 0	36	7·96	7·99	−·03		
	8	44	8·03	8·03	·00		
	15	51	8·04	8·07	−·03		
	22	58	8·13	8·12	+·01		
	31	11 7	8·19	8·20	−·01		
	40	16	8·18	8·29	−·11		
	45	21	8·39	8·35	+·04		
	52	28	8·37	8·43	−·06		
	55	31	8·44	8·45	−·01		
	16 4	40	8·47	8·49	−·02	11 39	11673
	11	47	8·44	8·46	−·02		
	21	57	8·47	8·39	+·08		
	30	12 6	8·21	8·29	−·08		
	38	14	8·27	8·21	+·06		
	48	24	8·18	8·11	+·07		
	57	33	8·09	8·06	+·03		
	17 2	38	8·03	8·04	−·01		
	13	49	8·06	8·01	+·05		
May 20	15 14	10 26	7·89	7·93	−·04	7 46	11708
	21	33	8·05	7·95	+·10		
	24	36	7·95	7·96	−·01		
	33	45	7·90	7·99	−·09		
	38	50	7·95	8·02	−·07		
	48	11 0	8·07	8·08	−·01		
	52	4	8·11	8·11	·00		
May 20	17 53	13 5	8·08	7·99	+·09	11 46	11709
	55	7	8·04	7·99	+·05		
	18 4	16	7·98	7·97	+·01		
	7	19	7·98	7·96	+·02		
	15	27	8·02	7·95	+·07		
	18	30	7·87	7·94	−·07		
	28	40	7·96	7·92	+·04		
	31	43	7·91	7·91	·00		
	39	51	7·88	7·90	−·02		
	42	54	7·95	7·90	+·05		

TABLE I.—*continued.*

Date. 1908.	Sid. Time. h m	G.M.T. h m	Mag.	C.	O—C.	Prec. Min. h m	Epoch.
May 30	14 40	9 12	8·04	8·01	+ ·03	8 0	11768
	46	18	7·87	7·99	− ·12		
	48	20	8·00	7·99	+ ·01		
	54	26	8·02	7·97	+ ·05		
	56	28	7·88	7·97	− ·09		
	15 2	34	8·02	7·96	+ ·06		
	8	40	7·93	7·94	− ·01		
	15	47	7·89	7·93	− ·04		
	18	50	7·98	7·92	+ ·06		
	25	57	7·88	7·91	− ·03		
	30	10 2	7·96	7·90	+ ·06		
	37	9	7·86	7·90	− ·04		
	42	14	7·93	7·90	+ ·03		
	49	21	7·90	7·90	·00		
	54	26	7·93	7·91	+ ·02		
	16 1	33	8·09	7·91	+ ·18		
	2	34	7·91	7·92	− ·01		
	8	40	8·06	7·93	+ ·13		
May 31	15 2	9 30	7·96	7·97	− ·01	8 1	11774
	6	34	7·97	7·96	+ ·01		
	8	36	7·90	7·96	− ·06		
	14	42	7·96	7·94	+ ·02		
	17	45	7·94	7·94	·00		
	24	52	(8·21)	7·92	(+ ·29)		
	27	55	7·95	7·92	+ ·03		
	32	10 0	7·92	7·91	+ ·01		
	40	8	7·95	7·90	+ ·05		
	46	14	7·88	7·90	− ·02		
June 1	15 34	9 58	7·97	7·91	+ ·06	8 2	11780
	35	59	7·93	7·91	+ ·02		
	41	10 5	7·95	7·90	+ ·05		
	45	9	7·94	7·90	+ ·04		
	49	13	7·90	7·90	·00		
	51	15	7·85	7·90	− ·05		
	16 11	35	7·94	7·91	+ ·03		
	18	42	8·00	7·93	+ ·07		

July 18. Clouded over suddenly at $18^h\ 30^m$.
July 25. Very hazy near horizon.
Aug. 11. Hazy near horizon. Mar. 22. Not very clear.
Apr. 15. Sky white throughout. Better during the second half.
May 3. Unsteady throughout, becoming hazy for last two observations.
May 20. (Second series.) Field somewhat bright. Rather unsteady.
May 30. At first somewhat unsteady, but improving later.
May 31. Good till $15^h\ 50^m$, then hazy.

The approximate form of the light curve near minima was obtained from the observations of 1908 April 26 and May 14, using the period as determined by Müller and Kempf ($4^h\ 0^m\ 13^s{\cdot}21$), and by means of this curve the minima given in Table II. were deduced. For convenience, minima previously observed by Müller and Kempf are given also, together with C_1 the times of minima computed from their formula, and the difference $O-C_1$.

TABLE II.

Minima.

Date.	G.M.T.	Epoch.	Weight.	C_1.	$O-C_1$.	C_2.	$O-C_2$.
	h m			h m	m	h m	m
1903 Jan. 14	4 38	0	3	4 39	− 1	4 37	+1
Feb. 20	5 31	222	1	5 28	+ 3	5 27	+4
Apr. 24	10 51	601	2	10 51	0	10 50	+1
1904 Feb. 13	5 20	2368	1	5 20	0	5 21	−1
1905 Jan. 17	8 49	4401	2	8 48	+ 1	8 51	−2
1906 July 26	9 1	7728	2	9 1	0	9 7	−6
1907 July 18	9 1	9868	1	8 52	+ 9	9 0	+1
22	9 1	9892	1	8 57	+ 4	9 3	−2
Aug. 6	9 17	9982	1	9 17	0	9 25	−8
1908 Apr. 26	11 18	11565	2	11 5	+13	11 14	+4
May 3	11 27	11607	1	11 14	+13	11 23	+4
14	11 42	11673	2	11 29	+13	11 38	+4

The minimum 11499 on 1908 April 15 has not been used for computing the period, on account of the unfavourable conditions during the first half. It was at first intended to reject these observations, but finally it was decided to let them remain.

From these minima, the correction to the epoch and period was determined by the method of least squares, the result being

$$\text{Heliocentric Minimum} = 1903\ \text{Jan.}\ 14^d\ 4^h\ 37^m{\cdot}4\ \text{G.M.T.} + 4^h\ 0^m\ 13^s{\cdot}267\ \text{E.}$$

Using these elements, the epoch and phase of each observation was computed, and then the observations were arranged in order of phase. Next, they were grouped to give 24 normal points (see Table III.), each point representing 10, 11, or 12 observations. These normal points were plotted and the light curve drawn. This curve was then used to obtain new values for the times of minimum brightness, but the alterations were so slight (+ 2 min. for 1907 July 18 and + 1 min. for 1908 April 26) that the elements could be taken as definitive.

TABLE III.

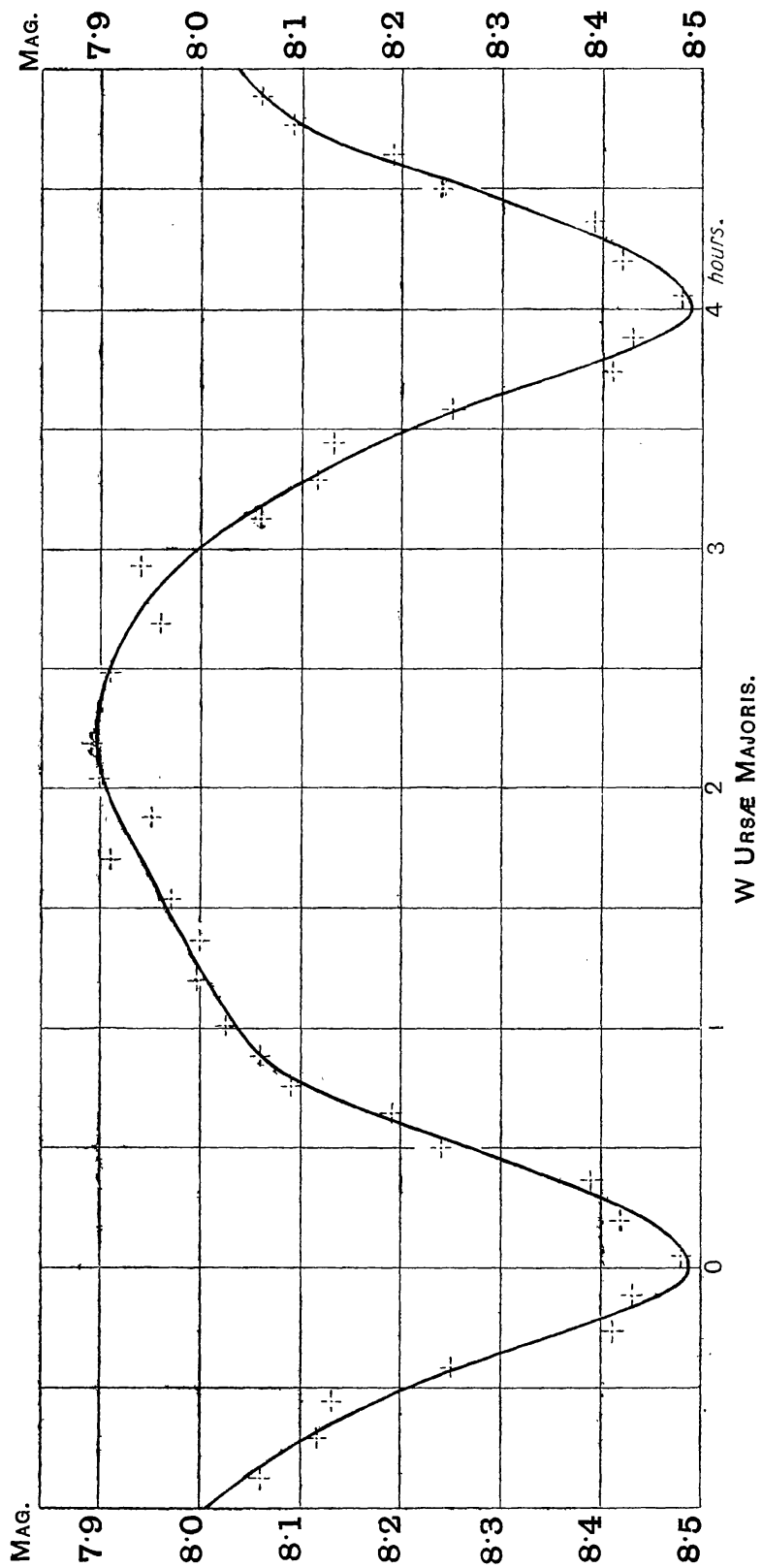
Normal Points for Curve.

Phase. h	m	Mag.	Curve.	O—C.	Phase. h	m	Mag.	Curve.	O—C.
0	3·2	8·48	8·49	− ·01	1	53·4	7·95	7·92	+ ·03
	11·5	8·42	8·45	− ·03	2	2·3	7·90	7·90	·00
	21·4	8·39	8·36	+ ·03		10·9	7·89	7·90	− ·01
	29·8	8·24	8·27	− ·03		28·9	7·91	7·91	·00
	38·4	8·19	8·17	+ ·02		41·2	7·96	7·93	+ ·03
	45·5	8·09	8·11	− ·02		55·4	7·94	7·98	− ·04
	53·5	8·06	8·06	·00	3	7·6	8·06	8·04	+ ·02
1	0·7	8·02	8·03	− ·01		17·7	8·11	8·11	·00
	12·1	7·99	8·00	− ·01		26·7	8·13	8·17	− ·04
	21·6	8·00	7·98	+ ·02		35·2	8·25	8·25	·00
	32·0	7·97	7·96	+ ·01		44·4	8·41	8·37	+ ·04
	42·0	7·91	7·94	− ·03		53·1	8·43	8·45	− ·02

The times for minima were computed from the above formula and are given in column C_2 of Table II., together with the difference between the observed and computed times $O—C_2$.

Looking at the column $O—C_1$ in Table II., one is at once struck by the three values + 13 min. from the 1908 observations. Of these, the minima of April 26 and May 14 were particularly good series of observations and agree very well together, not only in the time of minimum, but also in the form of the curve that they give, and it is unlikely that the time of minimum derived from them can be in error by more than 1 or 2 minutes. In column $O—C_2$ these observations again give a somewhat large positive difference of + 4 min., and the value − 6 min. from the minimum of 1906 July 26 also calls for special attention. Professor Müller kindly placed the original observations at my disposal, but no correction to the time of minimum such as to make the difference smaller appeared to be feasible; in fact, I was inclined to place the time of minimum 1 or perhaps 2 minutes earlier. This difference, then, as well as that for the 1908 observation, appears greater than can be accounted for by errors of observation. The difference for 1907 August 6 is also large.

This naturally suggests the question as to whether the period is constant or not, the period apparently having increased during the latter part of the series. The data, however, were not considered sufficient to enter into this question. Another point that may be noticed is that the two large negative differences occur at even epochs, while the large positive differences occur at odd ones. This would suggest that the intervals between successive minima were different, and consequently the observations were divided up into two sets, namely, those between odd and even minima, and those between even and odd; from each set 20 normals were



formed and the light curves plotted, but no difference could be determined between the two curves, so that the observations give no evidence of such irregularity.

The light curve (see figure, and Table IV.) shows that the variation in light is continuous, and that the curve for three-quarters of an hour on each side of the minimum is nearly symmetrical; then, however, the ascending branch turns somewhat sharply, and the increase to maximum is much slower than the decrease after maximum. The maximum occurs about 2^h 10^m after minimum, and is much less sharply defined. If the curve be compared with that given by Müller and Kempf it will be seen—

(1) The amplitude of the present curve is less.

(2) The minimum is less sharply curved.

(3) The gradual rise to maximum agrees with their suspected depression in the curve.

(4) The curves after maximum till near minimum are practically identical.

TABLE IV.

Magnitudes read from Curve.

Time after Minimum.	Mag.	Time after Minimum.	Mag.	Time after Minimum.	Mag.	Time after Minimum.	Mag.
h m		h m		h m		h m	
0 0	8·49	1 0	8·04	2 0	7·91	3 0	8·00
5	8·48	5	8·02	5	7·90	5	8·02
10	8·46	10	8·01	10	7·90	10	8·05
15	8·42	15	8·00	15	7·90	15	8·09
20	8·37	20	7·99	20	7·90	20	8·12
25	8·32	25	7·98	25	7·90	25	8·16
30	8·27	30	7·97	30	7·91	30	8·21
35	8·21	35	7·96	35	7·92	35	8·25
40	8·16	40	7·95	40	7·93	40	8·31
45	8·11	45	7·94	45	7·94	45	8·37
50	8·08	50	7·92	50	7·96	50	8·43
55	8·05	55	7·91	55	7·97	55	8·47
1 0	8·04	2 0	7·91	3 0	8·00	4 0	8·49

From the light curve, the magnitude corresponding to each observation was read off. These are the computed magnitudes given in Table I., in which the difference observed magnitude—computed magnitude is also given. In three cases where the difference is large, the numbers have been enclosed in brackets. These observations have not been used at all. Two of these observations were made at the end of an evening's observing in an inconvenient position, which may account for the large errors; the third is probably due to some change in the clearness of the sky.

For the sake of completeness, the whole of the minima of W

Ursæ Majoris which have been already published by other observers is given in the following Table V., together with the times C_1 computed from the formula given by Müller and Kempf, and C_2 those computed from the formula obtained in this paper.

TABLE V.

Additional Minima.

Observer.	Epoch.	Date.	G.M.T.	C_1.	O—C_1.	C_2.	O—C_2.	Observers' Remarks.
			h m	h m	m	h m	m	
Fauth *	2165	1904 Jan. 10	8 56	8 36	+20	8 36	+20	
	2207	17	9 5	8 45	+20	8 45	+20	
	2266	27	5 23	4 58	+25	4 58	+20	Uncertain.
	2267		9 18	8 58	+20	8 59	+19	Good.
	2393	Feb. 17	9 46	9 26	+20	9 26	+20	Somewhat uncertain.
	2404	19	5 49	5 28	+21	5 29	+20	Somewhat uncertain.
	2548	Mar. 14	6 34	6 0	+34	6 1	+33	Somewhat uncertain.
Parkhurst	6178	1905 Nov. 9	19 16	19 19	− 3	19 23	− 7	Fair plate.
and Jordan†	6346	Dec. 7	20 11	19 56	+15	20 0	+11	Two minima, plates very poor and poor.
Tikhoff ‡	9052	1907 Mar. 4			+ 5		− 2	Orange filter.
	to	to						
	9407	May 2			+15		+ 8	Ultra violet filter.

* Ph. Fauth, *A.N.* 3963, 1904.
† J. A. Parkhurst and F. C. Jordan, *Ap. J.*, vol. 23, p. 82, 1906.
‡ G. A. Tikhoff, *Pulk. Mitteil.*, Bd. ii. No. 21, 1908.

Fauth's observations were estimations, Parkhurst and Jordan obtained their minima from photographs, and Tikhoff's also were from photographs, colour filters being used. The large positive residuals given by Fauth's observations are remarkable, but the minimum observed by Müller and Kempf during this period with the Zöllner photometer gives residual zero. The times given by Tikhoff indicate that the minima fall later than given by Müller and Kempf's ephemeris, a result agreeing with the observations given in this paper.

In addition, 13 photometric measures during the period 1907 March 12 to May 7 have been published by H. v. Zeipel (*A.N.* 4247, 1908), but do not include a minimum.

It is my pleasing duty to record my thanks to Professor Müller, at whose suggestion I took up the observation of this star, for the assistance that he has given me in the work.

Astrophysikalisches Observatorium, Potsdam:
1908 *June* 27.

Note on the Telegraphic Determination of the Longitude Greenwich—Ascension—Cape, in the Year 1908.

By Sir W. H. M. Christie, K.C.B., Astronomer Royal.

It was decided by the Hydrographer to take advantage of the visit of H.M.S. "Mutine" to Ascension Island in the early part of this year to re-determine the longitude of that place both from Greenwich and the Cape, and incidentally to obtain a new value for the Greenwich-Cape longitude. Arrangements were made for Captain Monro and Lieutenant Gibson of the "Mutine" to attend at the Royal Observatory, Greenwich, in the autumn of 1907 before leaving England, and also on their return in 1908, for the purpose of ascertaining their personal equation referred to the standard observer with the transit circle. Mr. Pett, of the Cape Observatory, who was in England in 1907, was also directed to attend at Greenwich for the same purpose. The arrangement for the work was left to me; and when the Eastern Telegraph Company, at the Hydrographer's request, kindly placed the use of their cable at our disposal, I arranged with Mr. Judd, Electrician-in-chief of the Company, and his assistant, Mr. Young, as to the method of signalling, etc., the essential points being that the syphon recorders of the Company at the several places should be used as chronographs, and that the signals should be transmitted without the interposition of relays. As the result of experiment, it was found impracticable to use one syphon only to record both the clock signals and the out-going or in-coming signals; and at each place, therefore, a second syphon was added to the recorders, making two parallel lines on the running tapes. At Ascension this second syphon was actuated by the chronometer, and at Cape Town and Porthcurno by the clocks at the Cape and Greenwich Observatories respectively. The Post Office authorities kindly granted the use of their wires between Greenwich and Porthcurno; and when signals were exchanged, these were joined up without relays, to make an unbroken line.

The circuit from the sidereal standard relay at Greenwich actuated a telegraphic sending apparatus, and a current was transmitted which recorded the seconds of the Greenwich clock on a tape chronograph at the Observatory, and also actuated the second syphon at Porthcurno, these two being synchronous except for the time of transmission from Greenwich to Porthcurno, which was only $0^{s}\cdot006$. This quantity was found by sending return signals immediately after the exchange through the cable from Porthcurno to Greenwich, which were recorded on the syphon recorder and also on the chronograph at Greenwich. A very similar arrangement was made at the Cape, where the time of transmission was found inappreciable.

It is essential that if both the syphons of a recorder are actuated at the same instant, the deflections on the tape in the two lines should be exactly abreast one another; and if they are not, the distance between them must be ascertained and allowed